DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
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KANSAS CITY, MISSOURI 64106-2896

April 28, 2015

Mr. Brad Vann, Remedial Project Manager
Environmental Protection Agency Region 7
11201 Renner Boulevard
Lenexa, KS 66219

Dear Mr. Vann:

Per your request, The U.S. Army Corps of Engineers (USACE) has reviewed the Responsible Party's (RP's) Radon Flux Analysis provided in Attachment A of their October 2014 *Isolation Barrier Alternatives Analysis Report*. The purpose of this review was to identify assumptions made by the RPs in their radon exposure and risk calculations and identify standard geotechnical analyses or other tests that could be performed on core samples to verify the assumptions made and utilized in the RP's calculations and modeling.

In the October 2014 report, the RPs used the RAECOM model to calculate radon exposure and risk. The following parameters that are inputs into the RAECOM model were assumed in the RP's report:

- Change in soil density
- Change in soil porosity
- Change in soil moisture content
- Radon emanation fraction of soil
- Rate of settlement

Following are the geotechnical tests that would provide information that could be utilized to confirm the RP's assumptions:

- Soil dry density testing (ASTM D 7263 Laboratory Determination of Density (Unit Weight) of Soil Specimens) could be conducted using existing cores to verify the density of 1.4 g/cm3 utilized in the RP's modeling effort.

  The dry density could then be used to calculate the void ratio, which would be used to calculate porosity. This number would confirm the porosity of 67% utilized for layer 1 of the RP's modeling effort and would confirm the change in soil porosity assumed in the RP's model that reflected an SSE.

- Moisture content testing (ASTM D 2216 Standard Test Method for Lab Determination of Moisture Content) could be conducted to verify the initial moisture content of 25%

utilized in the RP's modeling effort. Newly obtained cores would be necessary in order to obtain accurate current moisture content. After heating is applied to simulate an SSE, the resulting moisture content measurement would allow for confirmation of the 20% reduction assumed by the RPs in their modeling effort.

Other geotechnical tests that may be of value:

- ASTMD 6539 Measurement of the Permeability of Unsaturated Porous Materials by Flowing Air. While this test wouldn't confirm the RP's parameter assumptions directly input into the RAECOM model; it could potentially be used to better calculate the landfill gas flow rate and radon retention time. These parameters would be used to estimate the radon concentration in the landfill gas emission stack. The test could be conducted under baseline conditions and after drying the core to measure the change in airflow when the pore spaces are not filled with water.

- ASTM D 4318 Standard Test Method for Liquid Limit, Plastic Limit, and Plastic Index of Soils (Atterberg Limits) and ASTM D 421/422 Test Method for Grain Size analysis of Soils – washed sieve analysis. While these two tests will not directly confirm parameters input into the RP's modeling program, it is useful to know the material type which is directly related to soil behavior characteristics and may be useful information in the future, such as designing the IB.

There were no known standard geotechnical tests identified that would allow for confirmation of the following parameters:

- Radon emanation fraction of soil
- Rate of settlement/Volume of landfill gas expelled due to subsidence

Radon emanation fraction of soil (radon emanation coefficient) could be determined through a specifically-designed laboratory test. Documentation for the RESRAD model references a test method by Strong and Levins (1982) that determines the radon emanation coefficient by using an accumulation (ingrowth) chamber, a sampling cylinder, a diaphragm pump, a scintillation cell, and supporting electronics for the radon measurement. This test could likely be conducted under baseline conditions and with modification, be subjected to heat to simulate an SSE to determine if the emanation coefficient changes due to temperature. The resulting coefficient would directly be entered into RAECOM for the the baseline conditions, and if the coefficient changes under temperature, for the SSE conditions.

The volume of landfill gas expelled due to subsidence is a parameter that would be extremely difficult to reproduce in a laboratory environment. Field scale testing would likely be extremely time-consuming and costly.

It should also be noted that when the RPs revise their calculations, in addition to incorporating the parameters confirmed by any core testing conducted, they should also incorporate the most recent RIM investigation results and utilize temperatures that are reflective of the SSE event in the south quarry. Additionally, the link the RPs provided in Section 2.1 of their October 2014 report for the web-based radon calculator (Wise Uranium Project: www.wise-

uranium.org/ctch.html, 2011) is no longer active. That link should be updated in the next report addressing their approach so that their radon flux calculations may be verified.

If you have questions, please call me at 816-246-5660.

Respectfully,

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Robyn Kiefer
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